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MEETING REPORT

David E. Crow, Chairman 3/24/04

Terrence J. Hertz, Executive Secretary 3/24/04

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Meeting Summary

Chairman's Overview

After calling the ATS meeting to order, chairman David (Ed) Crow began by expressing satisfaction with the progress of key Aeronautics programs within NASA. He cited increased cooperation with the Federal Aviation Administration (FAA) in transforming the National Airspace System (NAS). He also pointed to the knitting together of partnerships to enhance air safety, and to the development of benchmark vehicles that anticipated the future requirements of civil and military aviation. At the agency level, he suggested that NASA seemed to have rediscovered its sense of direction.

Subcommittee and Enterprise Charter and Membership

Executive secretary Terrence Hertz thanked subcommittee members for their input into the programmatic accomplishments just alluded to by Dr. Crow. Mr. Hertz went on to note recent changes in the Aeronautics Enterprise that affected the work of his office and this subcommittee directly. Following the President's 2004 announcement establishing human space flight to Mars as a national goal, NASA had moved many space-related programs out of Code R into a new Exploration Systems Enterprise. The Office of Aerospace Technology had disappeared; in its place the Office of Aeronautics had reappeared. As a result Code R would be rethinking its advisory committee structure. The present subcommittee's charter was scheduled to expire in the near future.

Turning to the larger Federal context, Mr. Hertz announced that Robert Pearce had been named Deputy Director of the Joint Planning and Development Office (JPDO). This new office was staffed by representatives from NASA; the FAA; and the Departments of Commerce, Transportation, Defense, and Homeland Security. On its senior policy committee sat NASA Administrator O'Keefe, FAA Administrator Blakey, Transportation Secretary Minetta (chair), and top-level designees from the other agencies. Mr. Hertz reported that JPDO's initial efforts had proceeded slowly because of its complex composition. Consequently Congress had extended until December 2004 the deadline for JPDO to submit its report on restructuring the NAS. Subcommittee member John Hansman, Jr., urged NASA not to wait for release of this report before proceeding with work on the NAS. Mr. Hertz replied that his office was continuing to develop these issues, although not independently of the JPDO effort. He and Associate Administrator Victor Lebacqz mentioned that several NASA staff members, including Mr. Pearce, George Price, and others participating in JPDO activities, were keeping the agency abreast of developments and promoting mutual reinforcement of efforts.

Opening Remarks From the Associate Administrator

Dr. Lebacqz first explained how Aeronautics fit into the administrative structure of NASA. Once again aviation would occupy its own separate enterprise. He noted that the agency's Deputy Administrator had demonstrated clear support for this charter area and that it was now up to the enterprise to develop appropriate programs for addressing fundamental questions and developing new technologies. The agency's vision for improved life on earth had not changed: Aeronautics was still crucial to NASA's mission.

Although the vision had been retained, the administrative structure had not been. Many programs had migrated to the new enterprise. These included the Space Launch Initiative (Orbital Space Plane [OSP] and Next Generation Launch Technology [NGLT]), the Mission and Science Measurement (MSM) technology programs, and the Innovative Technology Transfer Partnerships. Dr. Lebacqz noted his opposition—ultimately futile—to moving MSM out of Code R. Some of the transferred capabilities would have to be rebuilt within Aeronautics. All together, his enterprise lost more than half of its $2.3 billion budget to other NASA offices.

Looking ahead, Dr. Lebacqz emphasized the opportunities afforded by the sole focus on aeronautics. There would be opportunities for creative risk-taking, which he argued was crucial to the development of new technologies like the X-43 and Helios. He also anticipated the continuation of services to inhouse clients, such as Code S and Code Y, as well as rejuvenated ties to universities. In the latter area, Code R could convene an informal council of deans or department chairs to increase input from the undergraduate and graduate levels. Industry, too, offered more opportunities for fruitful collaboration, as illustrated by the informal Industry Technology Leadership Team. Dr. Lebacqz also indicated that he would be looking at specific suggestions from various other sources, including the Commission of the Future of the U.S. Aerospace Industry, the 2050 Study by the National Research Council (NRC), and a white paper published by ASME.

Under the reorganization, Code R would retain its Institutional Program Office responsibility for four field centers—Ames, Dryden, Glenn, and Langley—although they continued to present a financial challenge. The Enterprise funding represents approximately 6 percent of the agency's budget, but the Centers account for 36 percent of its workforce. Even with major income for services provided to NASA's other enterprises, the centers face severe budgetary challenges.

The next part of the presentation focused on specific program activities. These included research using F-5 aircraft to shape sonic booms; the 96,000-ft altitude benchmark set by the remotely piloted Helios craft, with electric engines powered by solar cells; and refinement of synthetic-vision technologies—all depicted in the meeting by streaming video. Dr. Lebacqz also played audio recordings illustrating the incremental noise reductions around Chicago's O'Hare Airport that NASA projected for future years. Other video showed how NAS activity fluctuated predictably over the course of a day as traffic shifted west, then to the freight hubs at night, and back to the Northeast by morning. Mention was likewise made of the upcoming second attempt to fly the X-43 mach-7 scramjet so as to achieve thrust at least equal to drag. Finally, Dr. Lebacqz reported that $7 million had been set aside in FY05 to explore the development of aircraft that could operate on other planets. Although such vehicles offered observational advantages over orbiting satellites and land-based rovers, risks associated with the Aeronautics proposal had led Code S to select a rover over such an aircraft for the 2008 Mars Scout project.

Dr. Lebacqz concluded his presentation with a budgetary update. He noted that at $188 million, the FY05 budget for Aviation Safety and Security represented a 4-percent increase over the FY04 figure. In Vehicle Systems, the budget for noise reduction

technology grew to $72 million for FY05. Uncrewed vehicles alone would benefit from a virtual doubling of funding—from $18 million to $36 million. Meanwhile $154 million had been set aside for Airspace Systems, including participation in JPDO. Because NASA was one of only two domestic discretionary agencies to receive a significant increase in FY05 (about 5.5 percent), the prospects for program augmentations in FY'06 were not bright. If they occurred, Aeronautics and Earth Science would be the likely beneficiaries. Pointing to the downward trend on the budget chart, Dr. Lebacqz indicated that $87 million in earmarks in the FY04 budget accounted for much of the dropoff in FY05. The remaining difference could be attributed to the wrapup of the Advanced Air Transportation Technology (AATT) project in Airspace Systems. Otherwise, the basic budget for Aeronautics was in tact.

Discussion Following Dr. Lebacqz's Presentation

Responding to a question from Mark Anderson, Dr. Lebacqz listed several top priorities for the coming year. These included proper development of the JPDO, smooth transfer of the OSP and NGLT programs to the new enterprise (including retention of a possible role for hypersonics within Code R), and planetary vehicles.

Mr. Swanda asked about the long-term budget for safety relative to security. Dr. Lebacqz replied that current discussions with the Transportation Security Administration (TSA) were focusing on the appropriate balance between the two. Mr. Hertz added that for the present, the baseline balance remained essentially the same.

Dr. Crow and Dr. Hansman expressed concern that NASA's air traffic management (ATM) efforts might lose momentum and core competencies as the agency waited for the JPDO to formulate a plan. Dr. Lebacqz reiterated his commitment to continue developing and supporting NASA's capabilities in this area in tandem with the JPDO.

Dr. Borger asked whether Code R would be evaluating a recent National Resource Council (NRC) observation that the agency still maintained excessive infrastructure. Dr. Lebacqz pointed to a number of studies, such as one from RAND, that had addressed this issue over the last decade. During that time NASA has closed over 50 percent of its centers. Dr. Lebacqz noted that he served on an Infrastructure Working Group connected to an NSTC subcommittee that he cochairs. Bill Cassidy was also looking at infrastructure issues agency-wide. In short, this matter was receiving a great deal of attention within NASA. He could say already, though, that the present infrastructure did not necessarily reflect what a revitalized Aeronautics Enterprise might look like.

Given the recent changes in agency and enterprise structure, Dr. Crow expressed hope that NASA would give high priority to the work on cross-cutting vehicle technologies that were now close to fruition. Dr. Lebacqz replied that he would not ignore all the work that had already been done to rethink technologies. He acknowledged the contributions of Mr. Hertz, George Price, Mr. Pearce, and others in this regard. Mr. Hertz testified to the continuity that he had witnessed during the transition from the previous Associate Administrator to the present one. He also indicated that with the exception of hypersonics, Dr. Lebacqz's priorities in Vehicle Systems coincided with the work under

way in that program. Richard Wlezien added that his vehicle program was flexible enough to adjust to a changing of priorities—i.e., refocusing at the top should not have an impact on end results, because cross-cutting technologies had been selected. He noted that NASA and the Air Force were considering the development of a joint roadmap in this area.

Mr. Anderson observed that the Aeronautics Roadmap was essentially ready for the agency to approach industry and academia for a commitment to participate. He said that Vehicles Systems projects were attracting abundant attention in the field these days. Dr. Crow suggested that it was time to bring NASA's vehicle and ATM developments to life.

The discussion concluded with an exchange about the impact of full-cost accounting (FCA) on Aeronautics, especially its field centers. Dr. Lebacqz restated the challenges posed by such evaluation, given the large Civil Service payroll involved. The solution had yet to emerge, he said. He and Mr. Hertz emphasized that FCA was an irrevocable mandate at this point. Mr. Hertz suggested that it was important for the agency to embrace the concept, so that problems would not linger unnoticed.

Aeronautics Technology Update and Discussion

Citing the importance of the Aeronautics Blueprint for Code R planning, Mr. Hertz outlined key objectives from the 2004 Strategic Plan. The aviation safety objective—to reduce the fatal accident rate by 50 percent relative to the 1991-97 baseline—had not changed. The environmental objective was also essentially the same as before—to reduce noise by 50 percent by 2007, NOx emissions by 70 percent, and CO_2 output by 25 percent. In mobility, the objective was to gain 35 percent system throughput in the terminal area and 20 percent along routes. A fourth objective addressed partnerships with DOD and DHS to transfer and leverage technology that lessened system vulnerability.

A general discussion ensued about these objectives relative to their domains (commercial or all civilian aviation), application (enabling or mandatory), and linkage to modeling and assessment. With respect to domains, Mr. Swanda, Mr. Crow, and Christopher Hart questioned whether it was realistic for commercial and general aviation to share the same safety goals given the different forms of record-keeping for each and the great diversity of technology, purposes, and pilot skills within general aviation. Mr. Hertz, however, said that NASA had data on general aviation and continued to track the accident data relative to established safety targets. With respect to adoption of the new technology, Mr. Hertz and the subcommittee seemed to agree that NASA's role was largely that of enabler—i.e., to develop tools and capabilities that could achieve desired results once policymakers decided to adopt them. Thus, reaching a technical objective as planned did not mean that it would be immediately implemented; industry and the public also had to buy into them.

Finally, Mr. Hansman argued for decoupling analytical capabilities from measurement of goal objectives. He suggested that analytical models tend to rely on embedded assumptions that helped justify program goals. Mr. Hertz agreed that developing a tool to reach a preordained target destroyed the credibility of the research, and he agreed with

Mike Benzakein that outside assessments, such as the NRC's new study of environmental assessment methodologies, played an important role. He also maintained, however, that analytical tools could still serve two purposes: to establish an investment strategy and to ensure that the associated work was accomplished.

Continuing his presentation, Mr. Hertz observed that Aeronautics had received criticism for arbitrary sunset clauses that jeopardized the continuity of core competencies in various areas. To counter this, the agency had developed itemized baseline roadmaps and a set of blueprint-derived focus areas for each major program. Thus, Airspace Systems encompassed several focus areas, including efficient operations (individual and system-wide), improved human-system interactions, and systems evaluation and engineering. In Aviation Safety, the focus was on individual aircraft structures, protection and intervention under threat of hostile acts, human error avoidance, interactions with weather, and identification of system vulnerabilities. Mr. Anderson suggested that agency workshops in these areas should convey a sense of ownership to industry so that it would embrace the new technologies. Vascar Harris pointed out, however, that NASA's concept of technology transfer did not necessarily promote the concept of partnership.

In Vehicle Systems, with its longer, 18-month program reorganization, eight focus areas had emerged. These included conventional turbine engines, new energy sources, quieter aircraft, greater aerodynamic efficiency, smarter materials, small controls, flight and system demonstrations, and strategic technical analysis. Within this context, several advanced-vehicle sectors or visions were being developed: an environmentally friendly subsonic transport, a small supersonic aircraft, a short-haul transport, a personal air vehicle, a heavy-lift rotorcraft, and a high-altitude long-endurance (HALE) vehicle. On the third weekend of April, there would be a rollout of the plan and an opportunity for industry and academia to provide feedback. In a recent workshop, the agency had asked its sector mangers and technologists to define their respective priorities. The results showed an initial 50 percent overlap between the two groups, with 95 percent convergence occurring by the end of the day. Mr. Hertz indicated his desire to apply this approach across the other program areas.

Turning to funding issues, Mr. Hertz commented briefly on the FY05 budget submission for Aeronautics by program. He also elaborated on earmarks tacked onto the Aeronautics Technology budget, which had totaled roughly $960 million. About $75 million in earmark appropriations came back from Congress, $50 million of which was generally targeted. Although earmarks placed the agency in an awkward position relative to long-term planning, the general nature of several of these did allow some flexibility for aligning funding with programs. Thus, two $15 million earmarks attached broadly to supersonics and military aircraft development, and an additional $15 million earmark targeted Airspace Systems and Aviation Safety and Security. More restrictive earmarks included an $8 million appropriation to fund Air Traffic Control display system replacement. Lesser amounts were slated for more than a dozen selected targets. One of these was a $5 million earmark for the National Institute for Aerospace at Langley, which was supposed to contract with industry and academia to develop a 5-year research budget for Aeronautics. Mr. Anderson suggested that NASA, not an external group, should

generate this plan, although others could be asked to comment. Mr. Hertz agreed. Mr. Swanda observed that the $15 million earmark for supersonics research could easily fit within Vehicle Systems.

Mr. Hertz homed in on the issue of funding and program continuity. Although the FY05 budget indicated a $13 million drop, this did not reflect a significant shift—only the delayed demolition of old buildings and construction of new ones at Ames. The overall Aeronautics budget had not been affected directly by the creation of the Exploration Systems Enterprise. There could be secondary impacts in the area of hypersonics. This program supported 350 Civil Servants in the four Code R centers. Some of these individuals would migrate to the new enterprise, but not all would. It could be a challenge to define a new role for them.

Mr. Swanda asked whether the Aeronautics Enterprise could accelerate its activities. Mr. Hertz replied that the Enterprise could not accelerate but that the roadmaps could help address this issue. By having well-defined roadmaps with clearly identified deliverables and funding requirements, stakeholders such as the Administration and Congress would understand the implications of funding decisions.

The remainder of Mr. Hertz's presentation focused on recommendations for budget augmentations to the FY06 budget. He noted that he had solicited input from the centers on the augmentations, and that so many different types of proposals had come in that a downselect would be necessary. He asked for subcommittee member feedback on the short list presented at the meeting. The selection process included peer review that would feed into an executive board to narrow the field. At the end of May, the agency would make final decisions in light of the board's recommendations, as well as input from center directors and the subcommittee. Mr. Hertz then summarized selected programs for augmentation. These included transforming the NAS (like last year's request); HALE unmanned vehicles (with assurances to Dr. Hansman that NASA would maintain its interest in lower altitude aircraft despite this initial focus on higher altitudes, where other agency research was lacking); solid oxide fuel cell and aviation security (memoranda of agreement [MOA] being worked out with FAA and TSA). Other augmentation proposals included safer and quieter rotorcraft; accident reconstruction (MOA under development with the National Transportation Safety Board); field center infrastructure maintenance; overland supersonic cruise demonstrator (with actual testing delayed until noise and emission issues were resolved); and hypersonics (challenge of finding a civilian justification for this program).

Mr. Hertz summed up his presentation by reaffirming the agency's continuing support for Aeronautics. He also noted, however, that in the current budgetary climate, augmentations would be hard to justify; arguments for them would have to be crisp. In addition, in-guide program budgets needed to be strong so that any proposed augmentations could be justified.

NRC Assessment of Aeronautics: Presentation and Discussion

John Klineberg, chairman of the steering committee chartered by NASA and the Office of Management and Budget (OMB), described the formation of his committee and its panels on Airspace, Safety, and Vehicle Systems. Mr. Hertz supplemented this account by summarizing how OMB had selected NRC as an outside reviewer to assess the quality of NASA Aeronautics research. Then Dr. Klineberg detailed how the panels gathered data from Headquarters staff, field centers, and principal investigators and fed their findings to the steering committee for distillation and transformation into recommendations. After the report was completed, 12 additional reviewers vetted it for consistency and made comments that were taken into account in the final document, released in January 2004.

Overall, the study found that 80 percent of Aeronautics activities appeared very strong, including 30 percent that could be called unique. The remaining 20 percent should be restructured or subjected to serious scrutiny.

Although the report offered findings at three or four levels, Dr. Klineberg limited his remarks to top-level recommendations. The first two were the broadest: to articulate a specific vision for Aeronautics and to exercise leadership as the R&D arm of the Government in this area. A discussion ensued about the content and intended audience of these suggestions. Mr. Hertz indicated that the first recommendation appeared to apply to decision-makers outside NASA. Dr. Klineberg, however, asserted that NASA could not afford to wait for special guidance from the President on the subject, and that the agency's own mission to improve life on earth hardly provided a convincing rationale for doing aeronautics. The committee did not find a clear vision for Aeronautics that propagated down to the field level and back up again. Mr. Anderson noted that the reference to effective competition in the global marketplace (a corollary to the first recommendation) ventured into areas that NASA had been told to avoid. Dr. Klineberg replied that the committee did not intend to introduce balance-of-trade issues; it was more concerned with promoting the development of the best products. OMB had seemed receptive to this latter rationale for Aeronautics, he reported.

The next three recommendations touched on the process of program management: addressing accountability in cross-cutting projects and the need for external quality assurance; eliminating arbitrary time constraints; and reducing the number of tasks in the portfolio. Mr. Hertz acknowledged the tendency among program managers to define milestones artificially.

Dr. Klineberg also reported his committee's conclusions that Aeronautics needed to pursue more high-risk technologies and to reconstitute its long-term base research. Researchers were not infinitely programmable; depth should not be sacrificed to breadth. Mr. Hertz pointed out that the base itself could become a source for solving problems. At present, the target for research was 20 percent for each program. He did not want to start a separate base research component. Mr. Anderson applauded the committee's recommendation to invest more in high-risk technologies.

The impact of FCA on the field centers surfaced as a concern in the next two recommendations: to curtail infrastructure outlays but to retain enough core competencies to ensure the long-term health of the enterprise. Mr. Hertz noted that the Administrator had explicitly stated that the closure of unnecessary facilities was an intended, not unintended, consequence of FCA. Mr. Anderson observed that NASA's facilities represented national assets and that closing them constituted an irreversible decision.

Recommendation 10 sought a clarification of roles between NASA and FAA. Dr. Klineberg suggested that the tendency within NASA to measure the success of projects through their implementation in the field sometimes placed the agency in an advocacy role with respect to FAA. Implementation, however, often involved more than technical considerations—also policy and industry compatibility. From FAA's perspective, Mr. Hart noted that he had seen definite improvement in that regard.

Another recommendation focused on the need of the enterprise to talk more to end users of the technology developed by the agency. These included engine manufacturers, outside agencies, and others. More senior management from industry and government should be involved.

The last top-level recommendation suggested that NASA should conduct research in selective areas of rotorcraft. Mr. Hertz noted that this recommendation had its roots in aviation safety, including technologies such as synthetic vision.

Dr. Klineberg explained that many more detailed recommendations could be found in the full report of his committee. He said that OMB wanted to continue this NRC review process and receive periodic reports.

At the conclusion of Dr. Klineberg's presentation, subcommittee members raised a number of questions. Mr. Benzakein asked about the interaction of Aeronautics with the Department of Defense. Dr. Klineberg said that the subject had not come up often in the committee, and that while synergies between the agencies could be achieved, the military had gone its own way in the development of new facilities (e.g., propulsion), whereas NASA was largely focusing on civilian aviation.

Dr. Hansman expressed some surprise at Dr. Klineberg's sanguine assessment of NASA's relationship with universities. Dr. Hansman sensed that today there was less opportunity for innovation and that it was harder for single investigators and junior faculty to participate in agency research. Dr. Klineberg acknowledged these difficulties to some extent, noting that budget pressures keeping work inhouse were bound to hurt the external programs. He also mentioned, however, that the committee's recommendations did address the need for a defined base research program, more innovative projects, and the retention of core competencies—all matters of special interest to academia.

Mr. Swanda expressed concern that FCA could kill off significant national resources. Although the committee took such accounting as a given, Dr. Klineberg agreed that some facilities might be so critical to the overall program that part of their costs should be

allocated to the program. This observation led to a discussion of general overhead within Aeronautics. Mr. Hertz estimated that one third of the Aeronautics budget went to direct procurement, and the other two-thirds to personnel, Center general and administrative, and service pools. He said that it was unfair to conclude from this breakdown that two-thirds of the enterprise budget merely supported the institution. That budgetary fraction not only supported Civil Service jobs, but also the technology and facilities associated with them. The G&A burden carried by Aeronautics did not differ appreciably from that found in industry.

Mr. Swanda asked whether the departure of the space-related programs from Code R would contribute to a flat budget for Aeronautics. Mr. Hertz said that it probably would, given the rocket-based technologies now being considered for the new Crew Exploration Vehicle (CEV) in the new enterprise. He thought that there would be some atmospheric technologies that might apply to the CEV program, but that the amount would fall far short of that required for a hypersonic launch.

As the discussion of the NRC report drew to a close, Dr. Crow thanked Dr. Klineberg for the work of his committee and the supporting panels. Mr. Hertz stated that he had already been taking the recommendations to heart and was planning to respond to both recommendations and observations—some 200 items. Part of the response would be reflected in the Performance Assessment Rating Tool and the informal annual updates for the enterprise.

Analysis and Strategic Planning

Introduction. Filling in for George Price, Mr. Hertz provided an overview of how Code R would address long-term planning for innovation in civilian aviation, for which NASA assumed more responsibility than any other Federal agency. The challenge was to determine where the world of aeronautics was headed and what NASA's appropriate role was. Code R was looking at these issues not only in terms of new technology, but also in light of regulations and passenger information that needed to be factored into the equation. Mr. Hertz discussed linkages between strategic objectives and technology deliverables; the establishment of goals and metrics at every level; program integration; and the alignment of Aeronautics with the work of JPDO, FAA, other Government agencies, and industry. He showed how various studies fed into the Aeronautics Technology theme goals and program foci, and how the outputs filtered through the appropriate metrics. After negotiating metrics with his program heads, Mr. Hertz would consolidate them into one integrated set.

Studies of Tripled (3X) NAS Capacity. LMI study manager Jesse Johnson briefly described this multiyear project to define strategies for accommodating the 3X increase in air transportation demand that had been established as a NASA pillar goal. These strategies were predicated on a point-to-point routing system serving 97 percent of scheduled air traffic. Other assumptions included the adoption of new ATM technologies that could increase existing runway capacity by 22 percent; hub overflow redistributed to uncongested facilities; opening of local and secondary airports to new vehicle types; and

development of vehicles that could land on stub airstrips between 1,000 and 5,000 ft long. Using passenger trips as the unit of measure, he displayed maps highlighting the route increases among 102 high-use airports. The model assumed that today's service frequency (flight:passenger ratio) would be maintained in the expanded system. Projections indicated that a 2.1X increase of operations would move 3X the people. This was possible because the system did not require a hub-and-spoke structure. Mr. Harris questioned whether this approach ignored certain logistical advantages of the hub-and-spoke paradigm. Mr. Johnson replied that as demand increased along individual routes, it became profitable for the carrier to spin them off as direct flights, while still protecting the hub by allowing routes to other destinations to develop. Mr. Johnson also pointed out that for the new system to reach its target, ATM capabilities would have to increase 65 percent (beyond the 22 percent already noted) to accommodate the increase in night traffic and more complicated traffic patterns. Ground facilities, too, would have to grow.

Mr. Johnson then showed how the five strategies mapped against several scenarios, such as economic growth, decline, or the domination of low-cost carriers). In general, it appeared that under foreseeable circumstances, the 3X threshold would be reached before 2030.

Mr. Hansman questioned the usefulness of the model for real-life planning because it contained so many assumptions about business transition strategies. He suggested that even the 3X concept itself was flawed because it did not take into account the ability of the system to adapt to excess demand, in part by rechanneling traffic elsewhere. Mr. Hertz and Mr. Johnson conceded that the 3X model that had been presented was only one approach. Mr. Johnson, however, emphasized that, despite the complexity of its assumptions, it represented the easiest solution to the problem; simply tripling the hub-and-spoke system of today was not a viable alternative.

Mr. Anderson encouraged NASA to approach FAA and industry leaders with these scenarios to ensure as broad a range of input as possible. Mr. Hertz replied that JPDO had taken on this task. Mr. Johnson indicated that his team had in fact talked to the airline industry about the growth issue, but in general no one appeared concerned about matters beyond survival in the near term.

JPDO Socioeconomic Demand Forecast. Shahab Hasan, also from LMI, reported on his study of estimated demand growth for 2015 and 2025. The estimates reflected input from LMI, Volpe Center, and FAA. Definitions were derived from FAA's Operational Evolutionary Plan (OEP). Unlike the assumptions for the 3X forecast, however, this study assumed that additional runways would come online. The results indicated that under the high-end projection, demand would increase from $694.1 billion revenue passenger miles in the baseline year 2000 to $1,743 billion by 2025; demand in the same period would grow to $1,397 billion under the low-end projection. Even in the high-end scenario, growth (2.51X) would fall somewhat sort of 3X by 2025. Next the study evaluated system capacity against the projected increased demand. Total annual losses from foregone flights to avoid excessive delay were estimated at $6.53 billion for 2015 and $19.6 billion for 2025. In addition to the billions lost to the economy, the airlines

would also experience direct operating cost increases. Even if flights in 2015 and 2025 were eliminated, the average delay per flight would go up significantly.

Future Business Models Study. Mr. Johnson returned to summarize his study of the ways that changes in business practices, new business models, and evolving technology affected airspace and vehicle systems, Government policies, sensitivity to economic growth, and telecommunications. Results indicated that the highest paying persons spent 5 times more for air fare than the lowest paying person did. Mr. Johnson pointed out that the average level of fares was important, but so was their distribution. He then described a range of business models, from those active today (e.g., hub and spoke) to those under development at various points (e.g., air taxi, runway-independent aircraft, access to secondary airports, etc.). These in turn were assessed against various parameters, such as applicable economic scenario, potential as a NASA technology opportunity, and trend prognosis. A matrix displayed the results. Mr. Hertz indicated that none of these studies was intended to validate the Aeronautics program. Instead they were being used to help identify enabling technologies and, through increasing complexity, introduce more realism into the analytical process.

Pathfinder. After introducing Dell Ricks, who ran ISAT out of Langley, Mr. Hertz described how a new tool being developed there would provide Aeronautics with novel analytical capabilities for supporting investment strategies. Pathfinder would ultimately be an integrated analysis framework encompassing objectives all the way down to specific technologies. This new tool was based on 13 system-level strategies grouped in four categories: safety/security, environment, efficient use of airspace and infrastructure, and innovative vehicles. It identified performance targets at the various levels folded into the database, as well as the architectures for various aviation systems. Information could thus be gathered from different layers of decomposition. Mr. Hertz emphasized the dynamic, flexible, and modular potential of Pathfinder in evaluating alternative technology deployments and the impacts of projects on technologies and competences. LMI was currently on task order to integrate and road-map activities across the enterprise for incorporation into the new tool. Mr. Ricks would soon have product II to show today's investment strategy and to provide an analysis of new initiatives and augmentations. Part III will be submitted to OMB in September to document coverage of Aeronautics objectives.

Wrapping up this last presentation, Mr. Hertz underscored the challenge of tripling capacity by 2025; even 2.5X would be difficult to achieve, and the OEP was not equipped to handle the increase. Integrating safety and security requirements also required a great deal of forethought. Mr. Hertz believed that NAS transformation was needed and that steps along the way should be defined within a holistic framework.

At the close of the meeting, Mr. Benzakein complimented Mr. Hertz on the information that had been provided during the day's presentations and discussion. Mr. Hertz in turn thanked subcommittee members for their participation over the last 2 years. With the subcommittee scheduled to sunset in March 2004, he wanted to offer members a memento of his appreciation of their contributions. He also thanked Dr. Crow for his

leadership and presented him with a scale model of the Hyper-X vehicle. Mr. Hertz noted that he expected to see many of the present participants serving in active roles within the new advisory committee structure.

Dr. Crow then adjourned the meeting.

Recommendations for Further Action

- Dr. Crow asked all subcommittee members to e-mail (DECROW@COX.NET) their recommendations for budget augmentations from Mr. Hertz's list.
- Mr. Hertz will provide members with chart(s) depicting the structure of the JPDO.
- Mr. Hertz may show the new advisory subcommittee how NASA plans to respond to the various suggestions offered by the Commission on the Future of the U.S. Aerospace Industry, the NRC 2050 Study, and a white paper by the ASME.
- Dr. Crow expressed recurring concern about combining the general aviation safety target with that for commercial aviation; clarification was requested.
- Dr. Hansman recommended decoupling analytical capabilities from measurement of goal attainment.
- Mr. Hertz will get back to Mr. Swanda about the meaning of "adaptive surveillance."
- Mr. Hertz encouraged Mr. Swanda to bring up his concerns about software certification when Phase 2 of the Safety program begins.
- Dr. Klineberg requests that NASA provide his committee with a yearly update of Aeronautics activities to ensure feedback continuity.
- Mr. Hertz will distribute to members the full report on the 3X airspace capacity study. He requested feedback on its findings and assumptions, as well as other areas that should be addressed.
- Mr. Hertz requested feedback on the 13 system-level strategies defined for the Pathfinder database.
- Mr. Hertz will place Pathfinder on the Aeronautics Web site for downloading.
- Mr. Hertz will place electronic copies of the JPDO Overview & Status and the Aeronautics Technology Theme Roadmaps (meeting handouts) on the Web.
- Mr. Hertz indicated that John White and George Finelli would follow up on Mr. Hart's/FAA's interest in converting raw recorder data into useful information.

- Mr. Hertz will address the issue of defining the proper committee to which the ASRS advisory body should report.

- Mr. Hertz will communicate with members about the timeframe for forming the new advisory committee structure.